DOCUMENT RESUME

ED 196 426 IR 009 034

AUTHOR Newcomb, Steven R.: And Others
TITLE The MEDICI Tutorial in Melodic Dictation. CMR Report X-2.
INSTITUTION Florida State Univ., Tallahassee.
PUB DATE 21 Oct 80
NOTE 19p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction: *Computer Oriented Programs: Higher Education: *Music Education: Program Descriptions: *Programed Tutoring
IDENTIFIERS *PLATO

ABSTRACT

Melodic Dictation Computerized Instruction (MEDICI), a system of lessons which runs on the Florida PLATO real-time interactive graphic computer system, is part of the required curriculum for freshman music majors at the Florida State University School of Music, and provides private tutoring and practice for each student. The program begins by selecting a melody from the database and displaying the clef, key signature, time signature, and first note. The short four voice cadence which follows can be repeated as often as necessary until the student is ready to hear the entire melody. After each of the first two playings of entire melody, the student has 30 seconds to notate the melody on paper. After the third repetition, the student uses an interactive music editing system to enter his version of the melody. Two indexes are available for the student, one for editorial assistance and the other to help him determine which activity to go to next. The music data are formatted in a table of 48 60-bit words of computer memory. The format is described in detail in the appendices as are the two audio routines used. (BK)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED196426

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

THE MEDICI TUTORIAL IN MELODIC DICTATION

by

Steven R. Newcomb

Bradley K. Weage

Peter Spencer

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Steven R. Newcomb

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

IR009034

CMR Report X - 2

The MEDICI Tutorial in Melodic Dictation [1]

Steven R. Newcomb, Bradley K Weage, and Peter Spencer[2]

The Center for Music Research
of the Florida State University School of Music

MEDICI (MIlodic DIctation Computerized Instruction) is a system of lessons which run on the FIorida PLATO real-time interactive graphics computer system. MEDICI is now used as a part of the regular required curriculum for freshman music majors[3] at the Florida State University School of Music, where each student is required to take this training for 100 minutes each week until he reaches a prescribed level of competency. MEDICI is also helping to recapture some of the classroom time which has heretofore been consumed by drill work in aural skills, and it is thus contributing to the quality of the Music Theory curriculum in general. MEDICI was engineered by the programming staff of the Center for Music Research (CMR) to approximate a one-to-one tutorial in melodic dictation as closely as possible, and to take maximum advantage of the great flexibility and power of the PLATO system.

---

1. The MEDICI project was made possible by Quality Improvement Funds allocated to the Center for Music Research (CMR) by the Legislature of the State of Florida, the Board of Regents of the Florida State University System, the Florida State University, and the FSU School of Music. The late Dr. Robert O. Lawton, Academic Vice-president of FSU, played a catalytic role in the MEDICI project. The Dean of the School of Music, Dr. Robert Glidden, provided invaluable moral and physical support. The FSU Computing Center, which operates Florida's PLATO system, generously provided essential assistance in the form of terminals and computer services through the efforts of its Director, Dr. Jesse H. Poore. The inventor of the Gooch Synthetic Woodwind, Mr. Sherwin Gooch, graciously provided the drawings for that device. The MEDICI interactive music editor is a generalized and modified version of the "Ottaviano" editor originally conceived and programmed by Steven R. Newcomb. The instructional design of MEDICI, as well as most of its database of melodies, were created by Peter Spencer, while the programming algorithms and the software itself were created by Bradley K Weage. Mr. Weage directed a staff of contributing CMR programmers, including David Kimble, Michael Jackson, Byers Parsons, and Brian Seeger. Consulting programmers included Jeff Bauer, Jim Dumoulin, John Edo Haefeli, Mike Murphy, and David Schrader.
2. Steven R. Newcomb is Associate Director for Administration, Bradley K Weage is Chief Software Engineer, and Peter Spencer is Coordinator of Instructional Software Development at the Center for Music Research. Professor Spencer is also Coordinator of Theory and Composition at the FSU School of Music.
3. There are 150 music majors enrolled in the 1980-81 freshman class at the FSU School of Music.

Why Was MEDICI Created?

The ability to listen analytically is generally regarded as being the most difficult of all musical skills to teach. Many beleaguered classroom instructors try out new aural perception textbook materials each year in the hope that students' aural skills will show more improvement than they did during the previous year, but the improvement for each class as a whole is generally disappointing. The problem is complex, and one which is rarely, if ever, solved in the classroom, because

(1) There is usually not enough time available for teaching aural skills within the context of a normal curriculum of studies in music.

(2) Students progress at wildly varying rates, rendering a given aural skills exercise suitable for only a few students at any one time.

(3) Students' skills improve spasmodically at best under the peer pressure so frequently generated in a typical classroom situation.

Computer-assisted instruction is beautifully suited to solving these problems. It allows, within the most flexible of schedules, what amounts to **private tutoring** and **practice** for each student for as many hours per day as facilities permit. In addition, unlike the classroom instructor, the computer has infinite patience, and performs uniformly regardless of the time of day. The **privacy** of the computerized learning environment allows each student to progress at his own pace without the detrimental effects of peer pressure. The **convenience** of self-scheduled instruction can make a vital difference to many students who must spend their daytime hours in other ways.

Melodic dictation, in which the student hears a short melody and is required to notate it precisely, develops all the skills of analytical listening except the harmonic skills. Exercises in melodic dictation have been a part of almost all serious traditional music curricula for hundreds of years, but they have proved far more effective in tutorial (one-to-one) situations than in classrooms. MEDICI makes the individual tutoring of large numbers of students practical for the first time.

When the Student Uses MEDICI

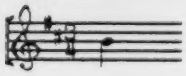
Within the limitations imposed by the number of terminals available and the number of students required to take the MEDICI instructional sequence, each student may determine his own schedule of instruction. Certain hours of the day are likely to be more popular than others, but experience has shown that students will quickly find that they will probably not have to wait to use a terminal during the unpopular hours, and they normally adjust their personal schedules accordingly. [At the FSU School of Music, students reserve time for 125 minutes of instruction weekly, and they may use otherwise unreserved terminal time whenever it is available. Several music stations are never reserved, and all music stations are unreserved in the evenings.]

When he arrives at a terminal, the student sees the words, "Press NEXT to begin" on the screen. He presses the NEXT key, and the screen says, "Type your PLATO name." He types his name, which PLATO already knows because the student's instructor has entered it in a special "group" file. The student then presses NEXT, and the screen says, "Type the name of your group." The name of the group can be anything the instructor wishes to call his class, but it will probably be something like "mutl1214" (Music Theory, first quarter, section 4). Then he presses NEXT and the screen says, "Enter your password." Only the student knows his password; this protects that student's work from being tampered with. Then MEDICI takes over.

The computer chooses a suitable melody from the database of melodies (see below) and displays the clef, key signature, time signature, and first note of the chosen melody. The student presses the "NEXT" key, and hears a short four-voice cadence in the key of the exercise he is about to hear (in major keys, I - IV - I^{6}_{4} - V - I, and in minor keys, i - iv - i^{6}_{4} - V - i) while he writes the first note, etc., down on his paper. Figure 1 shows the display on the terminal screen while the student is listening to the cadence. After the cadence has finished playing, the student has the option of hearing it again as many times as he likes (see Figure 2), or he may proceed directly on to hearing the melody which MEDICI has chosen for him. The student hears the melody exactly three times, and he may have up to 30 seconds (see Figure 3) after each of the first two playings to notate the melody on his manuscript paper.

After the third playing of the melody, the student is taken directly to the editor (see "The Interactive Music Editor", below). The first note has

Please prepare your paper with the following information. When you are ready to proceed, press the NEXT key to hear a short harmonic progression to establish the correct key.
(Gooch Synthetic Woodwind must be on)



NOW PLAYING

Figure 1

Please prepare your paper with the following information. When you are ready to proceed, press the NEXT key to hear a short harmonic progression to establish the correct key.
(Gooch Synthetic Woodwind must be on)

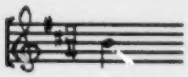
Press LAB to hear the progression again.

Press BACK to leave. You will receive this same exercise when you return.

Press NEXT to hear the melody. If you have heard the melody and leave without having it checked, be sure to bring your paper when you return.

Figure 2

Please prepare your paper with the following information. When you are ready to proceed, press the NEXT key to hear a short harmonic progression to establish the correct key.
(Gooch Synthetic Woodwind must be on)



Now pausing 30 seconds or press NEXT to cancel pause.

Figure 3

already been notated for him, and the cursors are already set to write a note or rest in the next possible rhythmic position (Figure 4). If, out of curiosity or bewilderment, the student wishes to know what his options are at this point, he may press shift-HELP and see the display shown in Figure 5, or he may simply press HELP. Pressing HELP takes him to the index shown in Figure 6, which is the main index for a lesson which gives instruction in the use of the MEDICI editor. The first "page" of this instructional lesson is shown in Figure 7. In Figure 8, the student has returned to the editor with some understanding of how to use it, and has notated a quarter note c in the "two-line" octave, by first touching the appropriate boxes in the lower left hand side of the screen, and then touching the "WRITE" box. In Figure 9, the student has notated a half-note d without having to specify a different octave placement; the octave placement boxes, among others, remain selected

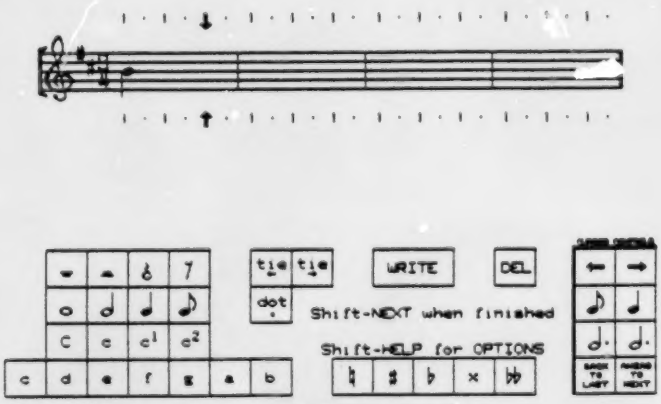


Figure 4

• O P T I O N S •

From the main editing display you may press:

Shift-ERASE to erase a note.

HELP for instruction in using the editor.

Shift-HELP to bring you to this page.

DATA to replot the entire screen.

Shift-NEXT when you have finished with editing.

Press -BACK-

Figure 5

EDITOR HELP INDEX

Start with option A and go through option G.

A. ** Learn to write notes on the staff.

B. Drill on writing notes on the staff.

C. Moving the cursor around.

D. Making deletions on the staff.

E. Writing rest on the staff.

F. Writing ties.

G. Functional copy of the MEDICI Editor.

Press Shift BACK to continue working.
Press Shift TERM and type 'comment' if you have a suggestion.

** Indicates sections entered.
++ Indicates sections completed.

Figure 1

What you see at the bottom of the screen is a copy of the MEDICI MUSIC EDITOR. You will be using it every time that you use one of the MEDICI lessons.

In this section you will be concerned with how to write notes on the screen.

Whenever you use one of the MEDICI lessons, you will need to use a PLATO terminal that is equipped with a TOUCH panel. This is essential because the MEDICI MUSIC EDITOR functions by the use of such a panel.

Press NEXT to go on BACK for INDEX

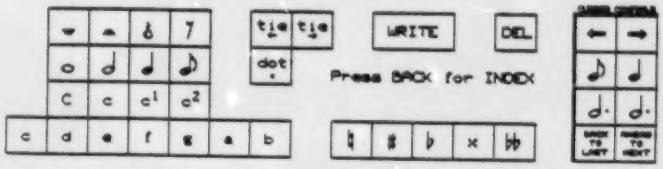


Figure 7

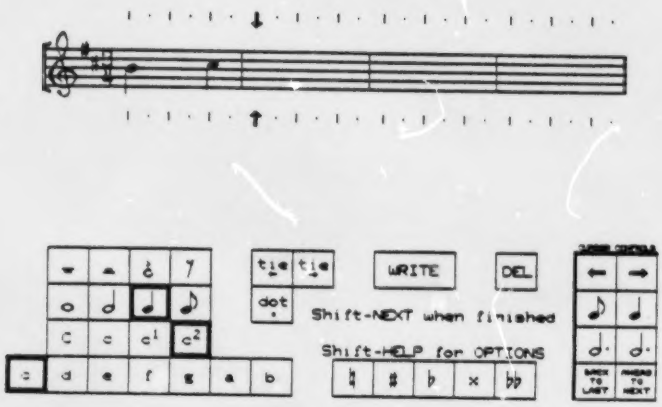


Figure 8

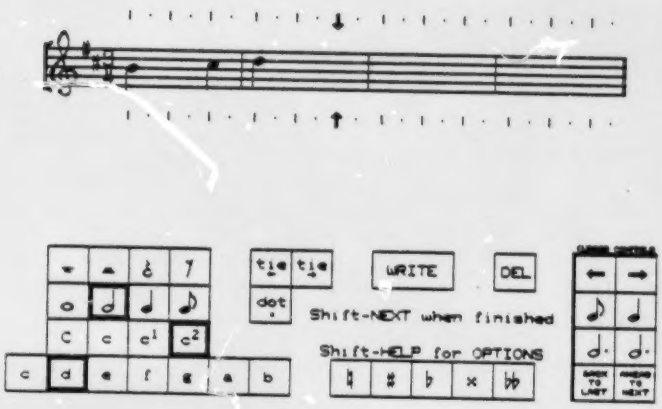


Figure 9

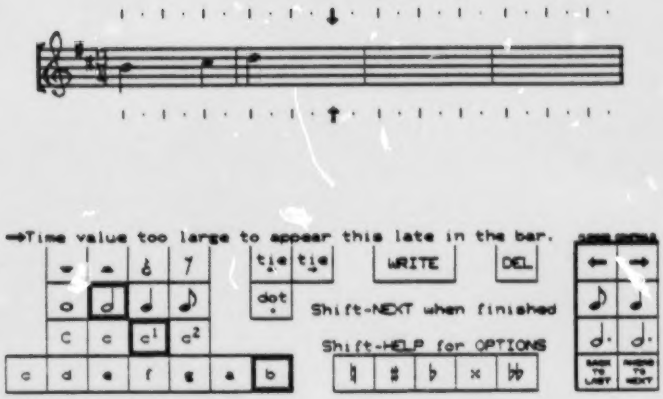


Figure 10

after a "WRITE." In Figure 10, the student has failed to select a smaller note value, leaving the half note box selected. He has pressed "WRITE," but no note has appeared on the staff, and he sees the error message, "Time value too large to appear this late in the bar." In Figure 11, the student has finished notating the melody as he thinks it was played. He then presses shift-NEXT, and sees the display shown in Figure 12. He sees the melody as it was actually played for him, as well as his own version, with the differences between the two versions highlighted by a thick line at the horizontal locations of the errors.[4] He now has the option of hearing the original version as many

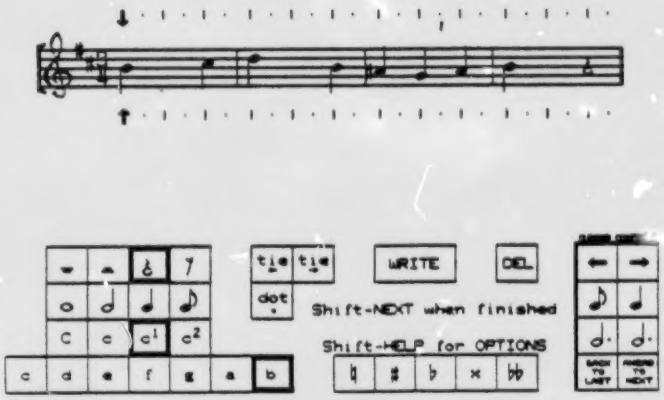


Figure 11

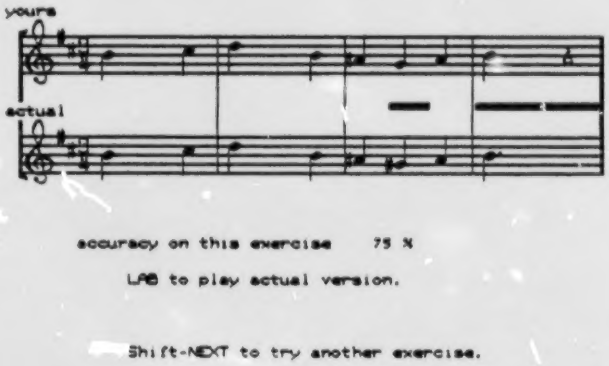


Figure 12

4. During judging, the given exercise is broken into fields, with each field representing a note or a collection of tied notes, i.e. from one point of articulation to the next. Subsequently the student response is compared with the exercise, one notesto at a time, and if anything is wrong within a field, the entire field is incorrect. By comparing points of articulation rather than actual note values, the judging routine marks as accurate either a correct response or a pseudo-correct response (i.e. two tied quarter notes in place of a half note).

STUDENT INDEX

If Gooch Synthetic Woodwind is not turned on, turn it on now and then press LAB.

Press NEXT to work on an exercise.

Press Shift-NEXT to see your personal statistics.

Press HELP for the HELP INDEX.

Press Shift-LAB to brush up on interval recognition

Press Shift-DATA to see current message for all students.

Press BACK to exit from lesson.

Figure 13

times as he likes. [Many persons have suggested that it might be valuable for the student to hear his own version, as well as the correct version of the melody at this point. Although this feature could easily be added to MEDICI, it was decided that the risk of confusing the student outweighs the potential benefit to be derived.]

Having pressed shift-NEXT from the display shown in Figure 12, the student returns to the index shown in Figure 13. He is then free to start a new exercise, to see his personal statistics (Figure 14), to learn more about the MEDICI program (MEDICI Help Index, Figure 15, and MEDICI Flowchart, Figure 16), to take advantage of a simple drill lesson in interval recognition (not shown), or to see the current message for MEDICI students.

Personal statistics for template of mutil211

current level = 1

current category = A

exercises completed in this level = 11

total average for this level = 57.82 %

average of last twenty exercises = 32 %

NEXT to go on!

Figure 14

HELP INDEX

Press the letter of the topic you want to study.

A. What this lesson does.

B. Help with using the editor.

C. Leaving the lesson.

D. Your personal statistics.

E. How MEDICI works. Schematic.

BACK to return to the STUDENT INDEX.

** Indicates sections entered.
•• Indicates sections completed.

Figure 15

The Interactive Music Editor

While using the MEDICI program, the student jots down the melody on manuscript paper while he is listening to it. Then the student uses an interactive music editing system to enter his version of the melody into computer memory, so that it can be judged as to accuracy. This interactive music editor is quite elaborate, because students learning melodic dictation skills make unforeseeable mistakes. The computer must be able to accept and store student responses which may only slightly resemble the actual melody (see Appendix I, "Music Data Format in MEDICI"). The MEDICI editor permits the student to notate music on the terminal screen almost as freely as he can notate it on manuscript paper; it can accept illogical keypresses without breaking down or confusing the student.

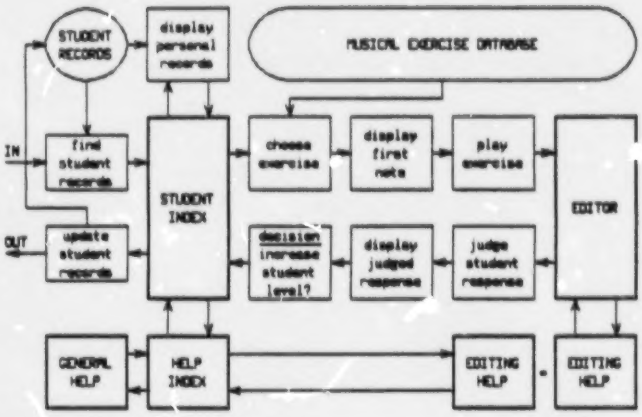


Figure 11

The MEDICI editor supports five time signatures (2/2, 2/4, 3/4, 4/4, and 6/8), can handle synthetic as well as all standard key signatures, and provides usually one or two voices with any of five possible clefs (treble, alto, tenor, bass, and tenor-G). The limitations of the MEDICI editor are that melodies may not exceed the equivalent of forty-eight eighth notes, and that triple subdivisions of the beat, except in 6/8 meter, are not allowed. These limitations, while not especially desirable, were not considered to constitute a serious impediment to effective instructional design in the MEDICI program.

The Editor in Use

Figure 17 is a terminal screen print (actual size) of the editor being used to notate an exercise. Writing a note is accomplished by first touching the boxes on the screen which represent the letter name, octave placement, and time value of the note. As each box is touched, its borders thicken. [The range of pitches which can be used in a given exercise is dependent upon the clef.] A tie to the previous note and/or an accidental marking may be selected. Notes may be dotted. The note or rest is written (and stored in memory) by touching the box marked "WRITE". Parameter selections may be made in any order. Only the accidentals, the dot option, and the tie option are self-cancelling after a "WRITE"; the other parameters remain in effect (and the borders of the boxes remain thickened) until changed by touching the same or some other box.

Notes and rests are written at the horizontal location indicated by a pair of cursors (the arrows above and below the staff line). The cursors

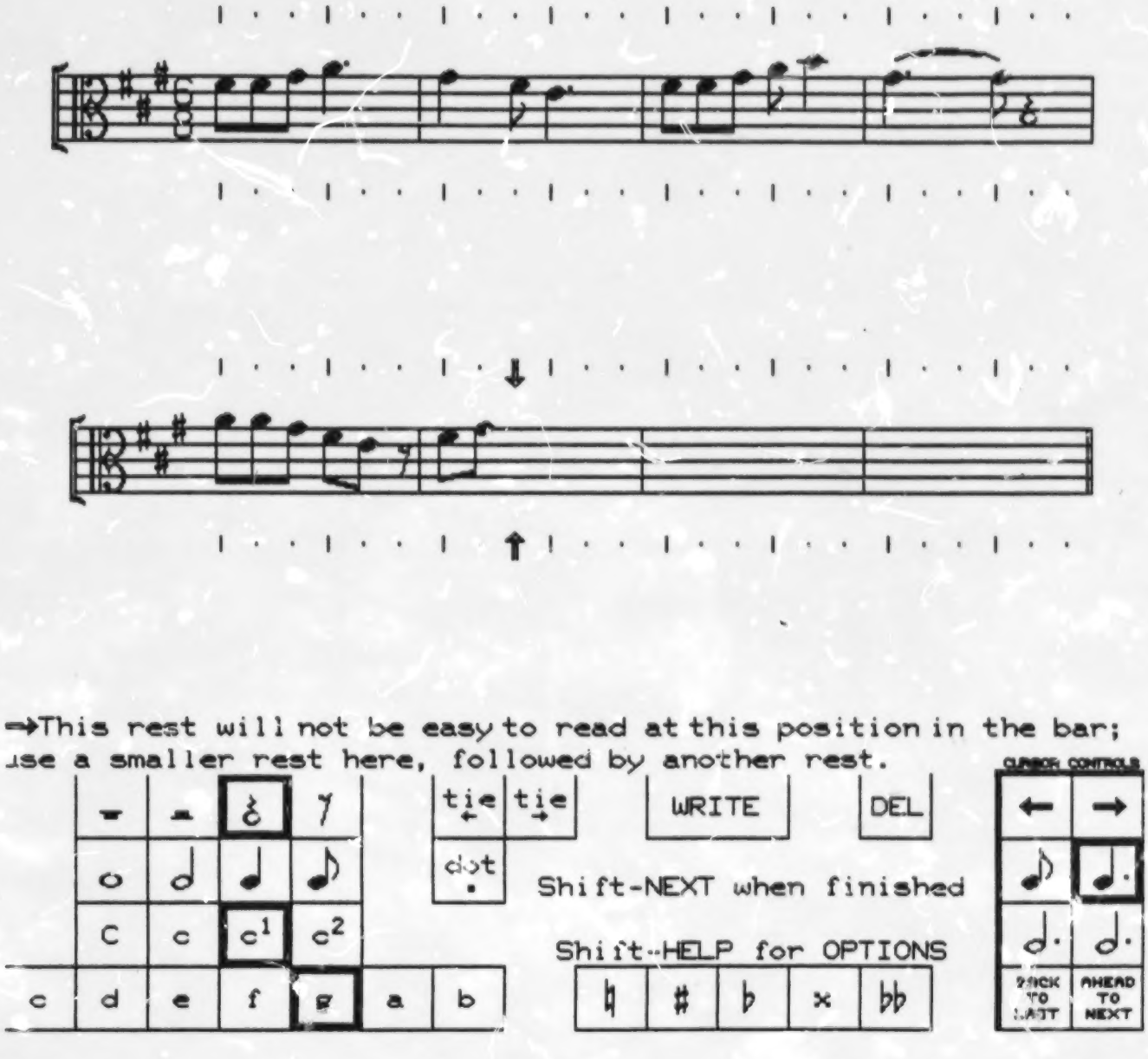

→This rest will not be easy to read at this position in the bar;
use a smaller rest here, followed by another rest.
tie
tie
WRITE
DEL
dot
Shift-NEXT when finished
Shift-HELP for OPTIONS
c
d
e
f
g
a
b
C
c
c1
c2
CURSOR CONTROLS
BACK TO LAST
AHEAD TO NEXT

Figure 17

move automatically, according to the value of the note or rest being written, to the next position where a note or rest might be written. The cursors can be moved forward and backward manually by means of a set of touch-activated "cursor controls". The cursors can be moved to the next or last possible position for a specific note value, or they can be moved back to the last note or rest written, or ahead to the next note or rest which appears on the screen.

If a note or rest has been written incorrectly and must be changed, the cursors must be moved to its location. There are then two ways to erase a note prior to writing a different one at the same location: 1) Touching the box marked "DEL" will delete the note, and the parameters of the note will be placed back into the touch areas on the screen, thickening the borders of the appropriate boxes. 2) Pressing shift-ERASE on the terminal keyset (not shown) will simply erase the note without changing the currently selected letter name, etc.

Any attempt at illogical notation is rejected by the program, and an appropriate error message is generated. There are over twenty of these messages, e.g., "You must select an octave placement," "Note is too low for practical notation on this clef," "You must FIRST erase the later note(s) or rest(s) which this note or rest would overlap," and "There is no note at this location to be deleted."

The software keeps track of displayed and undisplayed accidentals in such a way as to insure that the music on the terminal screen always conforms to standard notational practices. For example, if a student unnecessarily specifies an accidental which appears in the key signature or earlier in the measure, the program generates an error message, and the note is written without displaying the specified accidental. If no accidental is specified, the previous notes in the measure and the key signature are checked to determine how the note should sound when it is played by the Gooch Synthetic Woodwind (see Appendix II, "The Audio Routines").

MEDICI's Database of Melodic Exercises

There are four categories of melodic exercises, and four levels of difficulty within each category. The categories themselves are graded, so that there are actually sixteen serially graded levels of difficulty in the MEDICI lesson. A student proceeds through the four levels of Category A, and is promoted automatically to Level 1 of Category B, and so on. Table 1 shows the musical character of each category and level. The computer decides when to advance the student to a new level or category on the basis of his performance. It is possible for strong students to complete their work in MEDICI very rapidly, by doing accurate work. Students who have more difficulty get more practice at each level, because the computer advances them to the next level or category only when they have mastered the present one. [At FSU, a student "graduates" to the next level when he has a 90% or greater average on his most recent twenty exercises at his current level.]

TABLE 1: Specifications for the Melodies in Each Category

Category A: Diatonic melodies with a total length equivalent to 24 eighth notes, consisting of six measures of 2/4, four measures of 3/4 or 6/8, or three measures of 4/4.

Level 1:	beginning note:	tonic
	ending note:	tonic
	intervallic organization:	2nds and 3rds
	rhythmic organization*:	R1
Level 2:	beginning note:	tonic or dominant
	ending note:	tonic
	intervallic organization:	2nds, 3rds, P4ths, P5ths, and P8ves
	rhythmic organization*:	R1
Level 3:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic
	intervallic organization:	all intervals ok
	rhythmic organization*:	R1
Level 4:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic
	intervallic organization:	all intervals ok
	rhythmic organization*:	R2

Category B: Diatonic melodies with a total length equivalent to 48 eighth notes, consisting of eight measures of 3/4 or 6/8, or six measures of 4/4.

Level 1:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic
	intervallic organization:	all intervals ok
	rhythmic organization*:	R2, two phrases
Level 2:	beginning note:	tonic, dominant, mediant, or leading-tone
	ending note:	tonic
	intervallic organization:	all intervals ok
	rhythmic organization*:	R3, two phrases

TABLE 1 (cont'd)

Level 3:	beginning note:	tonic, dominant, mediant, subdominant, or leading-tone
	ending note:	tonic
	intervallic organization:	all intervals ok
	rhythmic organization*:	R2, indivisible
Level 4:	beginning note:	all scale degrees
	ending note:	tonic
	intervallic organization:	all intervals ok
	rhythmic organization*:	R3, indivisible

Category C: Chromatic, non-modulating melodies with a total length equivalent to 48 eighth notes, consisting of eight measures of 3/4 or 6/8, or six measures of 4/4.

Level 1:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic
	intervallic organization:	all intervals ok
	non-diatonic pitch content:	raised 4 and lowered 7 (major); raised 4 (minor)
	rhythmic organization*:	R2, two phrases
Level 2:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic
	intervallic organization:	all intervals ok
	non-diatonic pitch content:	raised 1, 2, 4, and 5 (major); raised 3 and 4 (minor)
	rhythmic organization*:	R2, two phrases
Level 3:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic
	intervallic organization:	all intervals ok
	non-diatonic pitch content:	all chromatic spellings
	rhythmic organization*:	R3, two phrases
Level 4:	beginning note:	all scale degrees
	ending note:	tonic
	intervallic organization:	all intervals ok
	non-diatonic pitch content:	all chromatic spellings
	rhythmic organization*:	R3, indivisible

TABLE 1 (cont'd)

Category D: Modulating (and, of course, chromatic) melodies with a total length equivalent to 48 eighth notes, consisting of eight measures of 3/4 or 6/8, or six measures of 4/4.

Level 1:	beginning note:	tonic
	ending note:	tonic in new key
	intervallic organization:	all intervals ok
	new key (in terms of old):	V if old key is major; v if old key is minor
	rhythmic organization*:	R2
Level 2:	beginning note:	tonic or dominant
	ending note:	tonic in new key
	intervallic organization:	all intervals ok
	new key (in terms of old):	IV or vi if old key is major; III or iv if old key is minor
	rhythmic organization*:	R2
Level 3:	beginning note:	tonic, dominant, or mediant
	ending note:	tonic in new key
	intervallic organization:	all intervals ok
	new key (in terms of old):	ii or iii if old key is major; VI or VII if old key is minor
	rhythmic organization*:	R2
Level 4:	beginning note:	all scale degrees
	ending note:	tonic in new key
	intervallic organization:	all intervals ok
	new key (in terms of old):	ii, iii, iv, V, or vi if old key is major; III, IV, V, VI or VII if old key is minor
	rhythmic organization*:	R3

TABLE 1 (cont'd)

* There are three divisions of rhythmic complexity, designated by the symbols R1, R2, and R3. A tabulation of the meanings of these symbols follows (where some conflict occurs between an R symbol and a specification of a category, the most limiting combination of specifications applies):

R1: Time signatures are limited to 2/4, 3/4, and 4/4, and note values are limited to whole notes, dotted half notes, half notes, and quarter notes. No ties or syncopations are allowed.

R2: All time signatures and note values supported by the MEDICI editor are allowed, but no ties or syncopations are permitted.

R3: All time signatures and note values supported by the MEDICI editor are allowed, as well as all possible rhythmic combinations.

The "Instructor Lesson"

The MEDICI "instructor lesson" is used as a software maintenance utility which allows instructors to check student progress and manage student enrollment. At FSU, the same editor used by the students is used in the instructor lesson to enter and edit the melodies in the database. Figure 18 is a screen print of the main index for this lesson.

INSTRUCTOR INDEX

a. Category A (diatonic melodies; 3 measures)
b. Category B (diatonic melodies; 6 measures)
c. Category C (chromatic melodies; 6 measures)
d. Category D (melodies that modulate; 6 measures)
e. List of Groups for which Data will be Stored
f. See Student Statistics for an Entire Group

Figure 18

Future Instructional Software Packages

The Center for Music Research is committed to continuing its instructional software research. In the future, MEDICI will continue to be updated, expanded, and improved. Other projected software packages will instruct music students in harmonic dictation, sight-singing (a new peripheral device is under development for this purpose), and keyboard drills in score reading, etc. (these will require peripheral music keyboards).

Appendix I - Music Data Format in MEDICI

As the student enters and edits his response by means of the MEDICI editor, his work is stored in a table of 48 sixty-bit words of computer memory. Each of these words is segmented into four fifteen-bit variables, called notestos (pronounced "NOTE-stow"). Each notesto contains all the necessary information for its unique eighth note location on the screen. Successive notes are stored in consecutive words, while up to four simultaneous voices may be stored in the adjacent four fifteen-bit segments. Writing a half note fills four consecutive notestos with similar information, with one small difference to show that the position of the first notesto corresponds to the on-screen location at which the note is to be displayed.

This system of storing a value for each eighth note allows direct coupling between the on-screen location of the cursors and the notesto table. This enables the program to check quickly whether a note will overwrite a previously written note or whether it is too long for the space remaining in the bar. It also allows notes to be deleted without having to restructure the remainder of the storage, thereby greatly simplifying the way in which the program handles such editing procedures as the replacement of a half note with four eighths. It also simplifies the programming of the playing routines which operate the Gooch Synthetic Woodwind (see Appendix II).

Each fifteen-bit notesto is further segmented into six sections, two sections of one bit, one section of four bits, and three sections of three bits in length.

tie	dot	accidental package	time value	octave	letter name
1	1	4	3	3	3

The time value is stored as a number from 1 to 6, a 1 representing a breve and a 6 representing a sixteenth note (only cases 2 through 5 are actually used). No provisions are made for triplets of any kind; the MEDICI melodies are rhythmically limited to duple subdivisions. The octave is stored as a number from 1 to 7, though here also the actual melodies are limited to octaves 2 through 5. The letter name is similarly stored as a value from 1 to 7 with a 1 representing a "C" and a 7 a "B". An octave or time value of zero means that no octave or time value has been chosen, a condition which will not allow the note to be stored. For letter names, however, a zero value indicates that the stored time value represents a rest rather than a note.

The dot bit simply stores whether the note is dotted or not, the dotted condition causing the editing program to fill half again as many places in the notesto table. The tie bit is used to inform the program that a note should be tied back to the preceding note. (Although the user may tie a note back to the last or forward to the next note, the software always stores the information with the second note of the tied pair).

The four bit segment designated as the accidental package is a somewhat more complex structure. The five possible accidentals (natural, sharp, flat, double-sharp and double-flat) are stored in one of three forms.

The first form indicates that the note is to be played as modified by the given accidental and that the accidental is to be displayed immediately before the notehead. The second form indicates that the note is to be played as modified by the accidental, but only the notehead is to be displayed because the accidental is either in the key signature, or is implied from a previous accidental in the measure. The third form indicates that the note is to continue being played as modified by the accidental, but nothing is displayed. This form is used for the notestos which represent the undisplayed eighth-note locations used by a time value larger than an eighth-note. The zero case is used for a natural implied by the key signature or a previous natural in the measure. A value of one indicates a natural which must be displayed. The values of 2 through 5 represent the other accidentals in displayable form, with 6 through 9 representing those same accidentals in implied form. Values from 10 through 14 represent an accidental that is part of a notesto which is merely a continuation of a previous note. When a rest is written, a zero value or undisplayed natural is stored for the accidental.

Appendix II: The Audio Routines

There are two audio routines, one for playing short four-voice cadences in the appropriate key, and the other for playing the melody with a single voice. The cadence routine responds to the key information stored with the exercise, performs several calculations, and sets the values of several variables. These variables, when transmitted from the terminal to a Gooch Synthetic Woodwind (GSW), cause it to play the appropriate cadence. The melodic routine takes each individual notesto, reads its octave and letter name and calculates a number from 0 to 87. This number represents one of the possible notes on the piano. The program then adjusts this number based on the accidental value, calculates the correct 15-bit GSW operand and stores it in one of 48 audio memory variables. Whenever a new note (one that is written and is not tied to a preceding note) is encountered, an articulation symbol is placed into the unused portion of the audio memory variable which represents the note that needs to be slightly shortened. This is accomplished at the time that the exercise is chosen for the student, so that all that is required for actual playing is a simple routine that interprets this information and sends it with appropriate timing and articulation to the Gooch Synthetic Woodwind.